A NEED OF HOUR IS SUSTAINABLE AGRICULTURE: A CRITICAL REVIEW

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ABSTRACT

An estimated 25-35% of global greenhouse gases are produced from agriculture. Modern agriculture also contributes to the loss of biological diversity, habitat loss, water pollution, degradation of soil quality, and loss of beneficial organisms including pollinators and animals that keep pests under control, but which pose a risk to human health through pesticide exposure and excess nitrogen in drinking water. Sustainable agriculture, including practices such as organic farming, crop rotation, integrated pest management etc. has the potential to alleviate many environmental problems and health risks associated with the modern industrial agricultural system.

Key words: Sustainable, Agriculture, Crop Rotation, Cover Crop

INTRODUCTION

The production of food, fiber, or other plant or animal products can be achieved with the help of agriculture. But toxic chemical pesticides, synthetic fertilizers, genetically modified seeds, practices that degrades soil, water and other natural resources are the ill effects of inorganic farming. Food production should never come at the expense of human health. Sustainable agriculture is the best way to overcome all the ill effects of production which contain harmful components. In simplest terms, sustainable agriculture is the production of food, fiber, or other plant or animal products using farming techniques that protect the environment, public health, human communities, and animal welfare. This form of agriculture enables us to produce healthful food without compromising future generation's ability to do the same. The goal of sustainable agriculture is to meet society food and textile needs in the present without compromising the ability of future generations to meet their own needs. Practitioners of sustainable agriculture seek to integrate three main objectives into their work: a healthy environment, economic profitability, and social and economic equity. Every person involved in the food system growers, food processors, distributors, retailers, consumers, and waste managers can play a role in ensuring a sustainable agricultural system.

There are many practices commonly used by people working in sustainable agriculture and sustainable food systems. Growers may use methods to promote soil health, minimize water use, and lower pollution levels on the farm. Consumers and retailers concerned with sustainability can look for "values-based" foods that are grown using methods promoting farm worker well-being, that are environmentally friendly, or that strengthen the local economy and researchers in sustainable agriculture often cross disciplinary lines with their work: combining biology, economics, engineering, chemistry, community development, and many others.

DEFINITIONS OF SUSTAINABLE AGRICULTURE

Modern definition: Sustainable agriculture is the use of farming systems and practices which maintain or enhance

1. The economic viability of agricultural production;
2. The natural resource base and
3. Other ecosystems which are influenced by agricultural activities.

This definition can be supplemented by some fundamental principles of sustainable agriculture:

1. That farm productivity is enhanced over the long term;
2. That adverse impacts on the natural resource base and associated ecosystems are ameliorated, minimized or avoided;
3. That residues resulting from the use of chemicals in agriculture are minimized;
4. That net social benefit (in both monetary and non-monetary terms) from agriculture is maximized and
5. That farming systems are sufficiently flexible to manage risks associated with the vagaries of climate and markets.

SUSTAINABLE AGRICULTURE IN GLOBAL PERSPECTIVE

Definition 1: Agriculture is sustainable when it is ecologically sound, economically viable, socially just, culturally appropriate and based on a holistic scientific approach. (*NGO, Sustainable Agriculture Treaty, 1992).*

Definition 2: Low-External-Input and Sustainable Agriculture (LEISA) is agriculture which makes optimal use of locally available natural and human resources (such as soil, water, vegetation, local plants and animals, and human labor, knowledge and skill) and which is economically feasible, ecologically sound, culturally adapted and socially just. (*Reijntjes, Haverkort and Waters-Bayer, Farming for the Future, 1992).*

Definition 3: Sustainable development is the management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in the agriculture, forestry and fisheries sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable. (*Document CL 94/6 94th Session of the FAO Council ,1988).*

OBJECTIVES OF SUSTAINABLE AGRICULTURE

1. To make best use of the resources available.
2. To minimize use of non-renewable resources.
3. To protect the health and safety of farm workers, local communities and society.
4. To protect and enhance the environment and natural resources.
5. To protect the economic viability of farming operations.
6. To provide sufficient financial reward to the farmer to enable continued production and contribute to the well-being of the community.
7. To produce sufficient high-quality and safe food.
8. To build up technology, knowledge and skills in ways that suit local conditions and capacity.

COMPONENTS OF SUSTAINABLE AGRICULTURE

a) Soil management:

A common philosophy among sustainable agriculture practitioners is that a "healthy" soil is a key component of sustainability; that is, a healthy soil will produce healthy crop plants that have optimum vigor and are less susceptible to pests. While many crops have key pests that attack even the healthiest of plants, proper soil, water and nutrient management can help prevent some pest problems brought on by crop stress or nutrient imbalance. Furthermore, crop management systems that impair soil quality often result in greater inputs of water, nutrients, pesticides, and/or energy for tillage to maintain yields. In sustainable systems, the soil is viewed as a fragile and living medium that must be protected and nurtured to ensure its long-term productivity and stability. Methods to protect and enhance the productivity of the soil include: using cover crops, compost or manures, reducing tillage, avoiding traffic on wet soils and maintaining soil cover with plants or mulches

b) Protecting Water Quality and Supply

Maintaining water quality and supply is one of the most important elements of sustainable agriculture. Keeping harmful contaminants such as pesticides and nitrates out of the water table helps crop growth and ensures the continued arability of the land. Carefully managing water consumption is also essential, especially in arid climates where drought is common. Farms can be developed to be drought-resistant by using low-volume irrigation systems, growing drought-tolerant crops and improving water conservation measures. Sometimes suspending growing operations altogether may be the best course of action. The consequences of overdrawing limited surface water supplies in times of drought can be severe, including permanent aquifer collapse and increased salinity.

c) Land use:

Conversion of agricultural land to urban uses is a particular concern, as rapid growth and escalating land values threaten farming on prime soils. Existing farmland conversion patterns often discourage farmers from adopting sustainable practices and a long-term perspective on the value of land. At the same time, the close proximity of newly developed residential areas to farms is increasing the public demand for environmentally safe farming practices. By helping farmers to adopt practices that reduce chemical use and conserve scarce resources, sustainable agriculture research and education can play a key role in building public support for agricultural land preservation. Educating land use planners and decision-makers about sustainable agriculture is an important priority.

d) Ecological Concerns:

Agriculture profoundly affects many ecological systems. Negative effects of current practices include the following: Decline in soil productivity can be due to wind and water erosion of exposed topsoil; soil compaction; loss of soil organic matter, water holding capacity, and biological activity; and salinization of soils and irrigation water in

irrigated farming areas. Desertification due to overgrazing is a growing problem. Agricultural practices have been found to contribute water pollutants that include: sediments, salts, fertilizers (nitrates and phosphorus), pesticides, and manures. Pesticides from every chemical class have been detected in groundwater and are commonly found in groundwater beneath agricultural areas; they are widespread in the nation's surface waters. Eutrophication and "dead zones" due to nutrient runoff affect many rivers, lakes, and oceans. Reduced water quality impacts agricultural production, drinking water supplies, and fishery production.

Environmental ills include over 400 insects and mite pests and more than 70 fungal pathogens that have become resistant to one or more pesticides; stresses on pollinator and other beneficial species through pesticide use; loss of wetlands and wildlife habitat; and reduced genetic diversity due to reliance on genetic uniformity in most crops and livestock breeds.

e) Renewable Energy Production and Consumption

Using fossil fuels for energy production also causes carbon emissions and contributes to global climate change– which may have catastrophic consequences for agriculture. Transitioning to renewable sources of energy such as wind, solar and biomass is an important step in addressing these concerns, as well as working toward increased energy efficiency. More and more farms are including solar cells and biomass generators for heat and power, reducing the impact of energy production and consumption for agriculture.

f) Plant and Animal Production Practices

Plant and animal selection are crucial to sustainable agriculture. The wrong combination or an excess of a particular crop or choice of livestock can have devastating effects on the environment that may compromise sustained growth. Careful management of the effects of cultivating plants and livestock are important to ensuring the long-term success of any agricultural endeavor. That means choosing suitable crop species and livestock as well as diversifying crops, maintaining and enhancing soil quality, and efficient use of non-harmful, ideally renewable chemicals or organics.

g) Labor Practices and Social and Economic Equity

The social and economic costs of inequitable labor practices are enormous. Unfortunately, in the world of agriculture, unfair labor practices are commonplace. By establishing better labor laws and practices, the social and economic impacts of agriculture can be mitigated and the exponentially growing need for more and more public services can be reduced to a sustainable level. Developing rural communities is also an important consideration in this regard. Many are severely impoverished and lack access to adequate employment, healthcare, and education. Working towards sustainable agriculture means addressing the socio-economic ills in these communities to help them thrive and secure their continued vitality.

SUSTAINABLE AGRICULTURE TECHNIQUES

Crop Rotation: Growing different crops in succession in the same field is one of the most powerful techniques of sustainable agriculture, and avoids the unintended consequences of putting the same plants in the same soil year after year. It is a key element of the permanent and effective solution to pest problems because many pests have preferences for specific crops, and continuous growth of the same crop guarantees them a steady food supply, so that populations increase. For example, right now European corn borers are often a significant pest in the United States because most corn is grown in continuous cultivation or in two-year rotations with soybeans. Four- or five-year rotations would control not only corn borers, but many other corn pests as well. In fact, rotation reduces pest pressure on all the crops in the rotation by breaking the pest reproductive cycles. In rotations, farmers can also plant crops, like soybeans and other legumes, which replenish plant nutrients, thereby reducing the need for chemical fertilizers. For instance, corn grown in a field previously used to grow soybeans needs less added nitrogen to produce high yields.

Cover Crops: Many farmers also take advantage of the benefits of having plants growing in the soil at all times, rather than leaving the ground bare between cropping periods, which produces unintended problems. The planting of cover crops such as hairy vetch, clover, or oats helps farmers achieve the basic goals of: preventing soil erosion, suppressing weeds and enhancing soil quality. Using appropriate cover crops is worth the extra effort because it reduces the need for chemical inputs like herbicides, insecticides, and fertilizers.

Soil Enrichment: Soil is arguably the single most prized element of agricultural ecosystems. Healthy soil teems with life, including many beneficial microbes and insects, but these are often killed off by the overuse of pesticides. Good soils can improve yields and produce robust crops less vulnerable to pests; abused soils often require heavy fertilizer application to produce high yields. Soil quality can be maintained and enhanced in many ways, including leaving crop residues in the field after harvest, plowing under cover crops, or adding composted plant material or animal manure.

Natural Pest Predators: Understanding a farm as an ecosystem rather than a factory offers exciting opportunities for effective pest control. For example, many birds, insects and spiders are natural predators of agricultural pests. Managing farms so that they harbor populations of pest predators is a sophisticated and effective pest-control technique. One of the unfortunate consequences of intensive use of chemical pesticides is the indiscriminate killing of birds, bats, and other pest predators.

Bio intensive Integrated Pest Management: One of the most promising technologies is the control of pests through integrated pest management (IPM). This approach relies to the greatest possible extent on biological rather than chemical measures, and emphasizes the prevention of pest problems with crop rotation; the reintroduction of natural, disease-fighting microbes into plants/soil, and release of beneficial organisms that prey on the pests.

BENEFITS OF SUSTAINABLE AGRICULTURE:

1. **Environmental Preservation**

Sustainable farms produce crops and raise animals without relying on toxic chemical pesticides, synthetic fertilizers, genetically modified seeds, or practices that degrade soil, water, or other natural resources. By growing a variety of plants and using techniques such as crop rotation, conservation tillage, and pasture-based livestock husbandry, sustainable farms protect biodiversity and foster the development and maintenance of healthy ecosystems.

2. **Protection of Public Health**

Food production should never come at the expense of human health. Since sustainable crop farms avoid hazardous pesticides, they're able to grow fruits and vegetables that are safer for consumers, workers and surrounding communities. Likewise, sustainable livestock farmers and ranchers raise animals without dangerous practices like use of non-therapeutic antibiotics or arsenic-based growth promoters. Through careful, responsible management of livestock waste, sustainable farmers also protect humans from exposure to pathogens, toxins, and other hazardous pollutants.

3. **Sustaining Vibrant Communities**

A critical component of sustainable agriculture is its ability to remain economically viable, providing farmers, farm workers, food processors, and others employed in the food system with a livable wage and safe, fair working conditions. Sustainable farms also bolster local and regional economies, creating good jobs and building strong communities.

4. **Upholding Animal Welfare**

Sustainable farmers and ranchers treat animals with care and respect, implementing livestock husbandry practices that protect animal health and well-being. By raising livestock on pasture, these farmers enable their animals to move freely, engage in instinctive behaviors, consume a natural diet, and avoid the stress and illness associated with confinement.

CHALLENGES IN SUSTAINABLE AGRICULTURE

Agriculture is facing three major problems and choices:

(a) Ecology/Technology: Which technology to base the future of world agriculture on? As the chemical-based model is faltering, the private sector and global establishment are looking to genetic engineering as the way ahead. But all the signs are that ecological farming is superior, not only for the environment, but also for gains in productivity and farmers' incomes. It has not been given the chance to prove itself. It should be.

(b) The global economic framework: The economic environment has turned extremely bad for developing countries' small farmers. International Monetary Fund (IMF)-World Bank structural adjustment has put pressure on poor countries to liberalize food imports and abandon subsidies and government marketing boards. The World Trade Organization (WTO) Agreement on Agriculture (AoA) enables rich countries to raise their subsidies and set up astonishingly high tariffs, while punishing developing countries (which cannot increase their subsidies, and which have to liberalize their imports further). Commodity prices have slumped. These three factors are threatening the survival of developing countries' farms and farmers. The entire framework of global and national economic policies for agriculture has to be thoroughly revamped.

(c) Land for the farmers: Many small farmers are poor and some are becoming poorer. A main reason is unequal land distribution, where small farmers have little land security or access and lose a large part of their income to landowners. Land reform is urgently required and landless farmers are fighting for their rights. But the landowners in most countries have political clout and are resisting change.

CONCLUSION

The agricultural sector has multiple roles in developing countries: to help ensure food security, anchor rural development, provide resources for the livelihood and adequate incomes of a majority of people, all without destroying the environmental base. There are thus two inextricably linked components, the social and environmental, to agricultural sustainability. It is thus imperative that a change of mindset takes place, to review the present damaging framework and build a new paradigm of policies that can promote sustainable agriculture. Whether such a paradigm shift takes place in agriculture is the acid test of the success or failure of sustainable development in the years ahead.

REFERENCES:

1. Agricultural Sustainability Institute. *University of California, Davis*.
2. Anonymous. 2016. Handbook of Agriculture. *ICAR, New Delhi.*
3. Document CL 94/6. 1988. *94th Session of the FAO Council.*
4. FAO. 1994. Development and Education Exchange Papers (DEEP): Sustainable Agriculture and Rural Development: Part 1. *Latin America and Asia*, Rome, p. 5.
5. Food and Agriculture. *Union of concerned Scientists.*
6. Gold, Mary V. 2007. Sustainable Agriculture: Definitions and Terms. *National Agricultural Library, U.S. Department of Agriculture.* 99-102.
7. NGO. 1992. *Sustainable Agriculture Treaty.*
8. Reijntjes, Haverkort and Bayer W. 1992. *Farming for the Future*.
9. Sustainable Agriculture: Critical Ecological, Social & Economic Issues. 2004. *Science in Society Archieve.*
10. Sustainable Agriculture vs. Industrial Agriculture. *FoodPrint.*